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New species and new records of the lichen genus *Cratiria* (Physciaceae, Ascomycota) in Australia

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Abstract

Cratiria burleighensis Elix, *C. streimannii* Elix and *C. verdonii* Elix are described as new to science and *C. amphorea* (Eckfeldt) Marbach is reported from Queensland and New South Wales, Australia for the first time. The new combination *Cratiria subtropica* (Elix) Elix is made and this species is reported as new to Queensland. In addition, *C. lauricassiae* (Fée) Marbach and *C. obscurior* (Stirt.) Marbach & Kalb are reported as new to New South Wales.

Introduction

This paper is a continuation of investigations into *Buellia*-like lichens in Australia, following on from the first accounts of *Buellia* and related genera (Elix 2009, 2011; Elix and Kantvilas 2013b, 2014a) and revisions to *Amandinea* (Elix and Kantvilas 2013a), and *Baculifera* (Elix and Kantvilas 2014b). In this paper, I deal with *Cratiria* whose species are characterized by short, bacilliform conidia 4–6 µm long, an hymenium which may be inspersed or non-inspersed, an excipulum containing lichen substances and ascospores with apical wall-thickenings (Marbach 2000). The superficially similar genus, *Buellia sens. str.* is distinguished from *Cratiria* by ascospores with subapical and medial wall-thickenings, an inspersed hymenium and an excipulum which lacks lichen substances. This paper describes three species new to science, reports new records of *Cratiria* in Australia, and provides a key to the Australian species.

Methods

Observations and measurements of photobiont cells, thallus and apothecium anatomy, asci and ascospores were made on hand-cut sections mounted in water and dilute KOH (K). Asci were also observed in Lugol's Iodine (I), with and without pretreatment in K. Apothecial sections were treated with 50% aqueous nitric acid (N). Chemical constituents were identified by thin-layer chromatography (Elix 2014) and comparison with authentic samples.

New species of *Cratira*

Cratiria burleighensis **Elix sp. nov. Fig. 1**

MycoBank No.: MB 810121

Similar to *Cratiria vioxanthina* but differs in having immersed apothecia, an I+ violet medulla, a pale proper exciple and in lacking vioxanthin and demethylvioxanthin.

Type: Australia: Queensland: Moreton (Anonymous 1975): Burleigh Heads National Park, 81 km SE of Brisbane, 28°05'S, 153°27'E, alt. 8 m, on basalt boulders on rocky headland, *J.A. Elix 1092*, 22 Aug 1975 (holotype: CANB; isotype: BRI).

Thallus crustose, continuous, to 3.5 cm wide, up to 0.3 mm thick; upper surface smooth, matt, cracked-areolate, off-white to pale whitish grey, individual areoles irregular, 0.2–1 mm wide; prothallus marginal, thin, black or not apparent; medulla white, I+ violet; photobiont cells 8–13 µm diam. Apothecia 0.2–1 mm wide, scattered to crowded, immersed, rounded, very rarely becoming adnate; disc dark brown to brown-black, epruinose, weakly concave then plane; proper excipulum thick, prominent, persistent, paler than the disc, often with adhering, necrotic thalline fragments, in section 30–50 µm thick, outer zone dark brown, K–, N–, inner zone pale brown. Epihymenium 10–15 µm thick, red-brown to pale olive-brown, K–, N–. Hypothecium 30–80 µm thick, inspersed with oil droplets, red-brown, K+ orange, forming red crystals; subhypothecium intense red-brown, 100–130 µm thick. Hymenium 60–80 µm thick, colourless, lower section inspersed with oil droplets; paraphyses 1.5–2 µm wide, simple to sparsely branched, capitate, with pale brown apices 3–4 µm wide; asci of the *Bacidia*-type, 5–8 spored. Ascospores of the *Buellia*-type, 1-septate, grey-green to brown, ellipsoid, 11–15(–23) × 5–7.5(–10) µm, not constricted at the septum, spore wall of uniform thickness; outer spore-wall finely ornamented. Pycnidia not seen.

Chemistry: Thallus and medulla K+ yellow then red, P+ yellow-orange, C–, UV–; containing atranorin (major), norstictic acid (major), connorstictic acid (minor).

Cratiria burleighensis is characterized by the smooth, dull, cracked-areolate, off-white to pale whitish grey thallus, immersed apothecia, inspersed lower hymenium and hypothecium, ellipsoid ascospores and the presence of atranorin and norstictic acid. The thallus and apothecial anatomy of this new species closely

Fig. 1. *Cratiria burleighensis* (holotype)**.** Scale: 1 mm.

resembles that of *C. vioxanthina* (Elix) Kalb & Elix, but the apothecia of *C. vioxanthina* are broadly adnate to sessile rather than immersed, the medulla is non-amyloid, the proper exciple is black and concolorous with the disc, and it contains additional vioxanthin and demethylvioxanthin.

Etymology: The epithet is derived from the type locality.

Distribution and habitat: At present this new species is known only from the type collection. Associated species included *Buellia mamillana* (Tuck.) W.A.Weber, *Parmotrema reticulatum* (Taylor) M.Choisy, *Pertusaria xanthoplaca* Müll. Arg. and *Pyxine cocoes* (Sw.) Nyl.

***Cratiria streimannii* Elix sp. nov. Fig 2**

MycoBank No.: MB 810122

Similar to *C. vioxanthina* but differs in having immersed apothecia, larger ascospores and in containing stictic and cryptostictic acids.

Type: Australia: Northern Territory: Darwin & Gulf (Chippendale 1972): Arnhem Land, 19 km ENE of Jabiru, 12°37'S, 133°03'E, alt. 140 m, on shaded boulder in *Calophyllum sil* and *Buchanania arborescens* dominated deep gorge, *H. Streimann 42218*, 18 Apr 1989 (holotype: CANB; isotypes: B, ESS).

Thallus crustose, continuous, to 10 cm wide, up to 0.3 mm thick; upper surface smooth to weakly verruculose, matt to slightly shiny, rimose-cracked, pale yellow-brown; prothallus not apparent; medulla white, lacking calcium oxalate (H_2SO_4–), I–; photobiont cells 8–14 µm diam. Apothecia 0.1–0.5 mm wide, scattered to crowded, immersed, rounded to irregular, rarely becoming adnate; disc dark brown to black, epruinose, weakly concave then plane; proper excipulum thick, prominent, persistent, in section 35–75 µm thick, outer zone dark brown, K+ yellow, N–, inner zone pale brown. Epihymenium 14–20 µm thick, brown to dark brown, K–, N–. Hypothecium 30–50 µm thick, brown to pale yellow-brown, K–. Hymenium 70–120 µm thick, colourless, inspersed with oil droplets; paraphyses 1–1.5 µm wide, simple to branched, capitate, with apices c. 3 µm wide, brown; asci of the *Bacidia*-type, 4–8 spored. Ascospores of the *Buellia*- or *Cratiria*-type, 1-septate, brown, ellipsoid then broadly fusiform, 15–25 × 8–12 µm, ± constricted at the septum, spore wall of uniform thickness or often with apical thickenings; outer spore-wall finely ornamented. Pycnidia not seen.

Fig. 2. *Cratiria streimannii* (holotype). Scale: 1 mm.

Chemistry: Thallus K+ pale yellow, P+ pale yellow, C–, UV–; medulla K+ dark yellow, P+ yellow-orange, C–, UV–; containing atranorin (major), stictic acid (major), cryptostictic acid (minor), ± norstictic acid (trace).

Cratiria streimannii is characterized by the smooth to weakly verruculose, rimose, pale yellow-brown thallus, immersed apothecia, inspersed hymenium, ellipsoid then broadly fusiform ascospores with apical wall-thickenings and the presence of atranorin and stictic acid. The thallus and apothecial anatomy of this new species closely resembles that of *C. vioxanthina* (Elix) Kalb & Elix, but the apothecia of *C. vioxanthina* are larger (0.3–1 mm diam.), broadly andate to sessile rather than immersed, the ascospores are somewhat smaller, 12–20 × 5–10 μm, and it contains atranorin, norstictic acid and vioxanthin.

Etymology: The epithet honours the collecter, former friend and colleague, the late Heinar Streimann (CBG).

Distribution and habitat: At present this new species is known only from the Northern Territory where it occurs on sandstone rocks. Associated species included *Australiaena streimannii* Matzer, H.Mayrhofer & Elix, *Caloplaca leptozona* (Nyl.) Zahlbr., *Dimelaena elevata* Elix, Kalb & Wippel, *D. tenuis* (Müll.Arg.) H.Mayrhofer & Wippel, *Diploschistes actinostomus* (Pers.) Zahlbr., *Lecanora austrosorediosa* (Rambold) Lumbsch, *Lepraria coriensis* (Hue) Sipman, *Parmotrema praesorediosum* (Nyl.) Hale, *Pertusaria remota* A.W.Archer and *Tephromela arafurensis* Rambold.

Specimens examined: Australia: Northern Territory: Darwin & Gulf: Umbrawarra Gorge, 22 km SW of Pine Creek, 13°59'S, 131°41'E, alt. 220 m, on semi-exposed rock face on *Melaleuca* dominated creek side, *H. Streimann 39508,* 23 May 1988 (CANB); type locality, on shaded rock face, *H. Streimann 42250A,* 18 April 1989 (CANB); Mt Brockman complex, 15 km SSE of Jabiru airfield, 12°48'S, 132°56'E, alt. 230 m, on rock face in *Allosyncarpia* dominated vegetation amongst deeply dissected sandstone outcrops, *H. Streimann 42278,* 20 April 1989 (CANB).

***Cratiria verdonii* Elix, sp. nov. Fig 3**

MycoBank No.: MB 810123

Similar to *Cratiria amphorea* (Eckfeldt) Marbach but the ascospores are larger and it contains only atranorin and lacks norstictic acid.

Type: Australia: Queensland: Darling Downs: Bunya Mountains State Forest, Nanango Road, 64 km NE of Dalby, 26°51'49''S, 151°38'51''E, alt. 670 m, on dead branch in mixed *Eucalyptus-Araucaria* forest, *J.A. Elix 37925,* 7 May 2005 (holotype: CANB).

Thallus crustose, whitish grey to greenish grey, continuous to verruculose, finely rimose to deeply cracked and areolate, 1−3 cm wide; prothallus dark brown to black or not apparent; medulla white, I–; photobiont cells 8–13 μm diam. Apothecia 0.2−1.2 mm wide, immersed then broadly adnate to sessile, often crowded but rarely confluent; disc black, epruinose, concave at first then plane to weakly convex, ± tuberculate; proper margin distinct, persistent, thin or excluded in convex apothecia. Excipulum 40−60 μm thick, dark reddish brown to brown-black, slowly K+ yellow-orange, N–, paler brown within. Epihymenium 12–16 μm thick, olive-brown to dark brown, K–, N–. Hypothecium 100–125 μm thick, brown-black. Hymenium 75–150 μm thick, inspersed with oil droplets especially towards the base. Paraphyses c. 2 μm thick; apices 3−5 μm wide, with dark red-brown caps. Asci *Bacidia*-type, 8-spored or with fewer spores. Ascospores of the *Buellia*- or *Cratiria*-type, dark grey-green to brown, 1-septate, ellipsoid then broadly fusiform, 16–23 × 8–14 μm, becoming constricted with age, with apical and medial wall thickenings; outer wall smooth to moderately ornamented. Pycnidia black, c. 0.08 mm wide; conidia bacilliform, 4–6 × 1 μm.

Chemistry: Thallus and medulla K+ pale yellow, P+ pale yellow, C–, UV–; containing atranorin (major).

This species is characterized by the whitish, grey-white to grey thallus, asci with 8 or fewer spores, an inspersed lower hymenium, ellipsoid then broadly fusiform ascospores, 16–23 × 8–14 μm, becoming constricted with age, with apical wall thickenings and an ornamented outer spore wall and by the presence of atranorin. *Cratiria amphorea* is similar but has smaller ascospores (15–20 × 7–10 μm), and a hypothecium which reats K+ red with the formation of needle-like crystals due to the presence of norstictic and connorstictic acids in addition to atranorin.

Etymology: The epithet honours the collecter, former friend and colleague, the late Douglas Verdon (CBG), who collected the first specimen of this species.

Distribution and habitat: This subtropical species occurs on bark and wood in montane forests in southern Queensland and northern New South Wales. Associated species included *Diorygma rufopruinosum* (A.W.Archer) Kalb, Staiger & Elix, *Flavoparmelia succinprotocetrarica* Elix & J.Johnst., *Hypotrachyna heterochroa* (Hale & Kurok.) Elix, *Pertusaria commuta* Müll.Arg., *Parmotrema permutatum* (Stirt.) Hale, *Pyxine berteriana* (Fée) Imshaug, *Punctelia pseudocoralloidea* (Gyeln.) Elix & Kantvilas, *Tephromela alectoronica* Kalb and *T. bunyana* Kalb & Elix.

Specimens examined: Australia: Queensland: Darling Downs: Bunya Mountains State Forest, 46 km S of Kingaroy, 26°48'13''S, 151°33'44''E, alt. 765 m, on dead wood in mixed *Eucalyptus-Araucaria* forest, *J.A. Elix 38639*, 7 May 2005 (CANB). **New South Wales:** North Coast (Jacobs and Pickard 1981): Mount Boss State Forest, Cockerawombeeba Creek, 46 km NW of Wauchope, 31°15'S, 152°20'E, alt. 700 m, on branches of *Sloanea* in *Geissosis benthamii-Sloanea australis* closed forest, *D. Verdon 4073*, 21 October 1978 (CANB).

Fig. 3. *Cratiria verdonii* (holotype). Scale: 1 mm.

Status of *Buellia subtropica*

This taxon is characterized by a whitish to grey-white or grey thallus, the 8-spored asci, an hymenium which may be sparsely or densely inspersed with oil droplets, an epihymenium reacting K+ dark brown, medium sized, ellipsoid to broadly fusiform, 1-septate, *Buellia*- or *Cratiria*-type ascospores with weak subapical and apical wall-thickenings and an ornamented outer wall, short bacilliform conidia 3–5 µm long, and by the presence of atranorin, hafellic acid, ± norstictic and connorstictic acids. Several other species of *Cratiria*, namely *C. lauricassiae* (Fée) Marbach and *C. vioxanthina* (Elix) Kalb & Elix have hymenia which are sometimes inspersed and sometimes not so. The short, bacilliform conidia, the ± inspersed hymenium and the broadly fusiform ascospores with apical wall-thickenings indicated that this taxon is better accommodated in the genus *Cratiria*.

***Cratiria subtropica* (Elix) Elix comb. nov.**

MycoBank No.: MB 810124

Basionym: *Hafellia subtropica* Elix, *in* J.A.Elix & P.M.McCarthy, *Australasian Lichenology* 62: 20 (2008)

Buellia subtropica (Elix) Elix, *Flora of Australia* 57: 660 (2009)

Type: Australia. New South Wales, Mann River Nature Reserve, Diehard Creek, 50 km E of Glen Innes, 29°40'29''S, 152°05'19''E, alt. 595 m, on *Allocasuarina* in *Allocasurina-Eucalyptus* woodland along stream, *J.A. Elix 37066*, 1 May 2005 (holotype: CANB).

This species occurs in two distinct chemical races: race 1 – containing atranorin and hafellic acid and race 2 – the type race, containing atranorin, hafellic acid, norstictic and connorstictic acids. This endemic species was previously known from coastal areas of central and northern New South Wales (Elix 2009; McCarthy 2014) and is here reported as new to Queensland.

Specimens examined: Queensland: Darling Downs: Bunya Mountains State Forest, Nanango Road, 64 km NE of Dalby, 26°51'49''S, 151°38'51''E, alt. 670 m, on twigs of shrub in mixed *Eucalyptus-Araucaria* woodland, *J.A. Elix 37958,* 7 May 2005 (CANB); Moreton: Coochiemudlo Island, Moreton Bay, 27°34'S, 153°20''E, sea level, on *Callitris columellaris* in open woodland, *J.A. Elix 10430,* 5 October 1982 (CANB).

New record for Australia

***Cratiria amphorea* (Eckfeldt) Marbach,** *Bibliotheca Lichenologica* **74: 172 (2000)**

This species was known previously from China, Central and South America (Marbach 2000). It is characterized by a whitish to grey or pale yellow-brown, verrucose crustose thallus which reacts K+ red (indicating the presence of norstictic and connorstictic acids), black, epruinose discs, a densely inspersed hymenium, *Cratiria*-type ascospores 15–20 × 7–10 µm with apical wall-thickenings and a strongly ornamented outer spore wall, and an excipulum which reacts K+ red with the formation of needle-like crystals, and short, bacilliform conidia, 4.5–5.5 × 1–1.2 µm. A detailed description is given in Marbach (2000).

Specimens examined: Queensland: Cook: Zillie Falls, 12 km by road NE of Millaa Millaa, 17°28'29''S, 145°39'22''E, alt. 705 m, on fallen tree in remnant rainforest, *J.A. Elix 39505,* 29 Aug 2006 (CANB); Leichhardt: Capricorn Highway, 19 km ESE of Duaringa, 23°46'S, 149°57'E, alt. 100 m, on canopy branches in low monsoon scrub dominated by *Brachychiton* and *Lysiphyllum*, *J.A. Elix 34436,* 22 Aug 1993 (CANB); Burnett: Hurdle Gully, Coominglah State Forest, 14 km WNW of Monto, 24°54'S, 147°01'E, alt. 310 m, on canopy branches in monsoon forest with dense shrubby understorey, *J.A. Elix 35464,* 3 Sep 1993 (CANB). **New South Wales:** North Coast: Cottan-Bimbang National Park, Stockyard Creek, c. 83 km E of Walcha, 31°24'10''S, 152°07'25''E, alt. 685 m, on *Acacia* in wet *Eucalyptus* forest, *J.A. Elix 43079,* 6 Aug 2008 (CANB).

New Records for New South Wales

***Cratiria lauricassiae* (Fée) Marbach,** *Bibliotheca Lichenologica* **74: 160 (2000)**

In Australia this species is known from Western Australia, Northern Territory and Queensland, (McCarthy 2014). It also known from Asia, Papua New Guinea, New Caledonia, Vanuatu, North, Central and South America.

Specimens examined: Australia: New South Wales: North Western Slopes: Junction of Pillaga Forest Way and Reedy Creek Road, 37 W of Newell Highway, 30°32'18''S, 149°35'36''E, alt. 250 m, on *Allocasuarina* in *Eucalyptus-Callitris-Allocasuarina* woodland, *J.A. Elix 45353, 45362,* 11 May 2005 (CANB); **Lord Howe Island**: junction of tracks to Mutton Bird Point and Intermediate Hill, 31°33'20''S, 159°03'33''E, alt. 35 m, on dead palm in dry lowland forest, *J.A. Elix 32744A,* 21 June 1992 (CANB); Neds Beach Road to Malabar Hill Track, 31°31'16''S, 159°03'50''E, alt. 10 m, on crown of *Cryptocarya* in lowland forest, *J.A. Elix 32874, 32880,* 22 June 1992 (B, CANB).

***Cratiria obscurior* (Stirt.) Marbach & Kalb,** *Bibliotheca Lichenologica* 74: 196 (2000)

In Australia this species was previously known from the Northern Territory and Queensland (Elix 2011) but also occurs in Africa, Asia, Hawaiian Islands, Central and South America (Marbach 2000). It is characterized by the white to grey thallus, the black epruinose discs, the 1-septate ascospores, with distinct apical and medial wall thickenings, 12−19 × 6−8 µm, the inspersed paraphyses and by the presence of atranorin and norstictic acid.

Specimens examined: Australia: New South Wales: Northern Tablelands: Stroud-Gloucester Road, 37 km S of Gloucester, 32°20'S, 151°55'E, alt. 80 m, on stem of spreading *Ficus* in dry sclerophyll forest on steep rocky westerly slope, *H. Streimann 43954,* 22 Apr 1990 (CANB).

Key to *Cratiria* in Australia

1 Thallus saxicolous 2
1: Thallus corticolous or lignicolous 4
2 Thallus K+ yellow; stictic acid present ..... ***C. streimannii***
2: Thallus K+ red; norstictic acid present 3
3 Apothecia sessile or broadly adnate; medulla I–; vioxanthin present ..... ***C. vioxanthina***
3: Apothecia immersed; medulla I+ blue-violet; vioxanthin absent ..... ***C. burleighensis***
4 Ascospores 3-septate ..... ***C. lauricassiae***
4: Ascospores 1-septate 5
5 Thallus K+ red, C–; norstictic acid present 6
5: Thallus K– or K+ yellow; norstictic acid absent 10
6 Hymenium inspersed with oil droplets 7
6: Hymenium not inspersed with oil droplets 8
7 Ascospores 16–23 × 8–14 µm; hafellic acid present ..... ***C. subtropica***
7: Ascospores 15–20 × 7–10 µm; hafellic acid absent ..... ***C. amphorea***
8 Ascospores with strong apical wall-thickenings; paraphyses inspersed ..... ***C. obscurior***
8: Ascospores with weak apical wall thickenings; paraphyses not inspersed 9
9 Disc black; ascospores 17–25 × 8–14 µm ..... ***C. americana***
9: Disc red or reddish; ascospores 17–21 × 6–8 µm ..... ***C. rutilantoides***
10 Thallus UV + orange; xanthones present 11
10: Thallus UV–; xanthones absent 12
11 Excipulum K– ..... ***C. melanochlora***
11: Excipulum K+ orange-red or red ..... ***C. aggrediens***
12 Medulla KC–; hafellic acid absent ..... ***C. verdonii***
12: Medulla KC+ rose; hafellic acid present ..... ***C. subtropica***

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